NUCLEAR ENGINEERING DEPARTMENT

DESIGN ENGINEERING

SR

HQB COMPLEX CIVIL MODIFICATIONS

CIVIL / STRUCTURAL DESIGN REPORT

Compiled by: T Rylands, Pr. Eng (20030181)

Designed by: G Hayter, Pr. Tech (201470274)

Reviewed by: D Lee, Pr. Eng (820311)

Reviewed by: J Venter, Pr. Tech (9870071)

Approved by: R Goldstein, Pr. Eng (20070243)

Date: 2020/10/23

REVISIONS

Revision	Date	Scope of the revision	Designer	Reviewer	Approver
0	2019-05-23	New document	TR/MV/GH	EV/JV	RG
1	2020-08-13	Included the closing of opening in north-west corner of CSB	TR/GH	JV/DL	RG

PACKAGE CONTENTS

NUCLEAR ENGINEERING DEPARTMENT

DESIGN ENGINEERING

HQB COMPLEX CIVIL MODIFICATIONS STRUCTURAL DESIGN REPORT

PART A: DESIGN

1.0 INTRODUCTION

1.1 The Existing Design

The HQB complex,

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In this case the American design codes for new installations are applicable because this is a new licence application, for the new design base of the CSB.

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1.3 The New Design

The modifications to the HQB structure are analysed and documented in NSE document JN745-NSE-ESKB-R-7435: Seismic and Wind Investigation of LLW and CSB [A2]. They are designed to ensure that the CSB structure does not collapse or sustain levels of damage Modifications described in the subsequent sections affect the following main items:

- CSB and LLW roof support structure
- CSB and LLW concrete walls

2.0 DESIGN CHANGE

2.1 Requirements

The primary goal of the modifications to the HQB complex is to ensure that building or parts thereof, do not collapse

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In order to achieve this goal, the applicable structural design requirements considered for the modifications to the HQB complex are derived from the following documents:

- ASCE 43-05 [1]
- ASCE 4-98
- ASCE 7-16
- IAEA Tecdoc 1347 [5]
- ACI 349 [8]
- AISC N690-06 [10]

Two approaches are considered for the application of a graded approach to the analysis of the CSB and LLW building. These approaches are similar and have been published by the IAEA (Tecdoc 1347 [5]) and ASCE 43-05 [1]).

The use of the IAEA Tecdoc deals with existing structures whilst the ASCE 43-05 [1] is recommended for the design of new structures. In addition, the ASCE 43-05 [1] makes use of probabilistic seismic hazard assessments and uniform hazard response spectra to define the ground motion. Such spectra are not available for KNPS which is licensed to a seismic hazard assessment performed in the late 1970's by Dames and Moore. However, the PCR probabilistic seismic hazard assessment that was performed on the Koeberg site for the PBMR project, has an annual probability of exceedance of a PGA = 0.3 g is $3x10^{-5}$. The PCR seismic hazard assessment was performed in accordance with RG 1.208 and can be regarded as level 2 SSHAC.

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In assessment of the CSB and LLW buildings, reference is made to ANSI/ANS 2.26 [6] to determine the Seismic Design Category (SDC) for the CSB & LLW building.

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05 [1], a limit state LS-B is defined for facilities which can undergo 'Moderate Permanent Distortion' resulting in a seismic design basis category SDB-4B. The hazard exceedance probability for a SDC-4 facility is set at 4x10-4 per annum which is less conservative than the current SSE for KNPS. It is noted that the SDC is used to set the design earthquake input whilst the limit state is used to set the analysis and design approach.

For LS-B, ASCE 43-05 [1] recommends the use of a cracked E modulus for 'cracked' reinforced concrete structures equal to 50% of the uncracked value, and, that a damping equal to 7% and 10% is used for reinforced concrete members having Demand / Capacity ratios in the range 0.5 to 1.0, and > 1.0, respectively. In addition, the code allows for the application of a ductility ratio to the seismic loads which for reinforced concrete members in bending is in the range 2.0 to 2.25.

For the design check of the CSB & LLW building subject to seismic excitation the

ASCE 43-05 [1] code has been adopted as it is the more internationally accepted code. The only exception to the application of this code is the use of the KNPS design basis earthquake which is demonstrated above to be more conservative than the ASCE 43-05 [1] prescribed earthquake.

There are a number of differences between the requirements for the CSB and the new pads located within the CSB. The CSB is more sensitive to deflection and rotation which could affect the roof structure. This does not exist for the pads because they act as a rigid body. CSB structural parts are slender when compared to the pads. Hence much less bending and deflection is experienced on the pads. A different limit state is adopted for CSB design, as per the code, to utilise the ductility in the concrete walls and foundations. Hence the design requirements differ. Furthermore, the failure mode of the pads is vastly different to the CSB which, if not designed correctly, can collapse under SSE, whereas the pads can only settle or crack and

Further to the structural design criteria, compliance of the modifications to the South African National Buildings Regulations, i.e. SANS 10400 code of practice, was also assessed. Compliance of the building in its current unmodified state, is not considered in this report.

The modifications discussed in the subsequent sections do not increase risk to personnel occupying or using the structure, nor will it result in non-compliance of the CSB with respect to structural design, access and fire risk. Further discussion regarding compliance of this modification to SANS 10400 is included in appendix A5.

2.2 Design Limitations

The civil and structural modifications of the CSB and LLW building described in this document excludes the following modifications:

- The design of the new CSB floor slab.
- This design excludes all security related modifications to the CSB.
- Design of bird proofing and ventilation of the CSB.
- This design modifies only the structural components of the building in order to improve its seismic robustness. Other aspects of the building's compliance to the 1990 version of the National Building Code (SANS 10400, which include items such as public safety, fire detection, drainage, glazing, and lighting and ventilation) have not been modified by this design change.
- The design is not required to withstand or mitigate the effects of the applicable design extension conditions (DEC). However, the applicability and response of the modified structure to DEC external events are assessed in references [15] and

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2.3 Assumptions

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The modifications to be performed are independent of plant operation and can be done on-line or during refuelling outages.

It is assumed that modifications to the roof structure can be done from inside the CSB and LLW building and access to the roof structure is allowed.

Access to the underside of the roof structure is achievable with cherry pickers or another form of movable elevated platform.

It is assumed that the construction activities associated with this structure will not impact on the operations in and around the HQB complex

It is assumed that limit state LS-B (Moderate Permanent Distortion) and Seismic Design Category SDC-4 as per ACSE 43-05 [1] are applicable to the CSB.

Specific design assumptions related to the design of the modifications to components in the CSB and LLW are listed in the applicable design reports include in Attachment A4.

The material properties and non-linear behaviour of the construction materials included in the analysis models are provided in the applicable design reports in Attachment A4.

The design basis safe shutdown earthquake (SSE) and operating basis earthquake (OBE) input motions are derived from the Dames and Moore ground motion input. The PC Rizzo uniform hazard spectrum is used to define the beyond design basis seismic input. The response of the structure to this seismic input is assessed in reference [15].

2.4 Investigation

Detailed analyses of the CSB and LLW buildings were performed to assess the behaviour of the structures under design basis conditions, which is shown in Attachment A2. The analyses include soil structure interaction analyses, detailed linear and non-linear analyses of the buildings in their present geometric configuration, as well as a limited number of modified configurations. The response of the structure to the applicable beyond design basis external events, i.e. design extension conditions (DEC), are assessed in references [15] and [16].

A geotechnical investigation, documented in reference [28], has been conducted for the design of the new concrete pad in the CSB. The data generated from this investigation was also used in the soil structure interaction (SSI) analyses of the buildings. The detailed SSI analyses were used to determine the worst load cases, and to calibrate a less detailed model for the full non-linear analyses.

The modifications to the CSB were determined by means of an iterative process whereby the overstressed structural elements were identified by running the various linear and non-linear finite element analyses. Specific elements of the model were then adjusted until the elements that showed significant overstress were within tolerance or specific design requirements were met. The affected structural elements were then designed to suit the applicable adjusted model parameters, e.g. changes to truss vertical supports from existing rigid connections to a more flexible connection to reduce stress in truss members.

The response of the CSB structure to a range of DEC external events was assessed in references [15] and [16]. The analytical models used in these DEC analyses include the modifications described in Section 2.8.

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Other investigations include a survey of the concrete strength with a Schmidt hammer to check this against what is shown on the drawings, and testing of rebar samples removed from the CSB to ensure that rebar ductility requirements of the ACSE 43-05 code are met. Furthermore, several site visits were undertaken to check the layout and connections between steel members comprising the roof structure which could not be determined from the existing drawings. A level survey of the soil surrounding the HQB complex was also performed to determine the depth of the soil abutting the retaining walls of the CSB and LLW.

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2.5 Negative Consequences of this Modification

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The installation and construction works may require the relocation of some shipping containers and temporary offices (used during outages only) on the eastern side of the HQB complex. The works on the western side of the CSB may temporarily affect or restrict access to the dry resin storage area for between 60 and 90 days. Resins may have to be stored in an alternative storage area.

Modifications of the eastern wall of the LLW will result in minor changes to the stormwater pipes and catch pits below the downpipes.

Modifications to the party wall between CSB and LLW will require that the cable trays on this wall be removed for the duration of construction and reinstalled once the modification is complete.

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2.6 Benefits of this Modification

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2.7 Location and Environmental Conditions

The CSB is located in the HQB complex, which is located within Eskom's Koeberg Nuclear Power Station site, approximately 30km north of Cape Town, on the west coast of South Africa. The ambient external environmental conditions to which the components of the CSB and LLW buildings are exposed are as follows:

Air Temperatures:	
Mean daily maximum in hottest month	26.2°C
Highest recorded in 18 years	37.9°C
Mean daily minimum in coldest month	7.2°C
Lowest recorded in 18 years	1.8°C
Site design base temperature – maximum	40.2°C
Site design base temperature – minimum	1.8°C
Dry bulb temperature	Summer 34°C Winter 5°C
Wet bulb temperature	Summer 22°C Winter 4°C
Seismic Conditions	
SSE Acceleration (Dames and Moore)	0.3 g
Damage Level Acceleration	0.5 g

For further details of the environmental conditions of the Koeberg site, such as design windspeeds, precipitation, etc., refer to document KBA 00A1C01001 – Site Data for Koeberg Site.

The buildings at KNPS are exposed to the marine environment which can cause accelerated corrosion of steel and the deterioration of concrete due to rebar corrosion.

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2.8 Functional Description

The modifications to the CSB are described as follows:

2.8.1 Installation of Sag Bars to Existing Purlins

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2.8.2 Modification to Roof Trusses Support

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NNR Act 47, Section 51, PAIA 38(b).redaction of plant sensitive information

2.8.3 Installation of Bracing between Existing Steel Columns

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2.8.4 Modifications of Bracing-Purlin and Bracing-End Plate Connections

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NNR Act 47, Section 51, PAIA 38(b).redaction of plant sensitive information

2.8.5 Installation of Horizontal Stiffening to CSB and LLW Walls

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NNR Act 47, Section 51, PAIA 38(b).redaction of plant sensitive information

NNR Act 47, Section 51, PAIA 38(b).redaction of plant sensitive information

2.8.6 Replacement of Masonry Block Wall with Reinforced Concrete

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2.9 Operational Requirements and Changes

There are no changes to the operational requirements of the Koeberg plant as a result of the modifications to the CSB and LLW buildings proposed above.

2.10 Maintenance Requirements and Changes

Modifications to the steel roof structure inside the CSB and LLW building will not result in additional maintenance. The installation of the concrete stiffeners on the walls of the CSB and LLW building will not result in additional maintenance requirements as long as a durable concrete mix is used in their construction. Protections against corrosion of the additional structural steel items on the outside face of the walls shall be managed as part of the routine coating and corrosion protection maintenance activities.

The modifications will form part of the civil inspection regime of the HQB Structure to ensure the structure is maintained.

2.11 Nuclear Safety

The importance category of this modification is SR (safety related) because it impacts on the CSB, which is classified as SR in classification number 0012-14C. Safety Evaluation E2019-0006 was performed in accordance with KAA-709 and KGA-025. An ALARA screening of the modification was completed (form KFU-028) and included in Attachment A4.

Once installed, the modifications to the CSB roof structure and other parts of the CSB and LLW will not have an impact on Nuclear Safety. The impact of the implementation of the building modification on the casks, such

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2.12 Conventional Safety

The completed installation of these modifications within the CSB will not result in additional conventional safety risks to personnel entering or working in the building. There are no additional risks to plant integrity. The work to be performed will not affect a Hazloc area.

Conventional safety risks associated with the installation of this modification include:

- Working at heights
- Hot Work
- Heavy lifting and rigging

All conventional safety aspects of the installation and construction activities will be addressed in the construction safety file. A full safety risk assessment will be completed and all construction related risks will be addressed by suitable PPE, proper equipment, safe working procedures, etc., as documented in the risk assessment.

2.13 Selection of Equipment

All equipment and material to be used for this modification shall be as specified in the referenced drawings and specifications. All material supplied shall be accompanied by the relevant approval certificates technical specification. The main materials to be used are:

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No parts or components shall be installed unless they comply with the requirements stipulated in the drawings and specifications, or approval has been granted in writing by the Engineer or his appointed representatives.

The procurement specifications of the main items are provided in Part C (Procurement Specification) of this document.

2.14 Design Calculations and Analyses

Extensive analyses were completed to understand the behaviour of the CSB and LLW buildings under design basis seismic conditions. This includes non-linear soil structure interaction analyses, as well as linear and non-linear analysis of the building with an equivalent reduced soil model. Various scenarios were analysed to determine the effects of these parameters or physical aspects on the response of the model. The following model configurations were assessed:

- with and without stone on the roof,
- with stone on LLW side only,
- with and without vertical buttresses,
- different restraint conditions at truss supports,
- with and without soil abutting the northern and eastern walls,
- with horizontal stiffeners of different sizes,
- post-earthquake settlement analysis

Most of these analysis configurations are documented in report JN745-NSE-ESKB-R-7435, which is included in Attachment A4. Some analysis configurations are mentioned but results are not fully documented in the report because they were found to give unfavourable results. The results show high flexural stresses or rotations in some parts of the building that could not be reduced/rectified with economically viable solutions by further modification of the building. These configurations were not pursued further.

The analyses conclude that with the proposed modifications, the CSB is able to

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2.15 Impact on the Simulator and KIT

There is no impact on the simulator and KIT.

2.16 Environmental Impact and Energy Efficiency

This design has the following impact on the environment:

- No harmful material will be installed. Conventional construction materials such as concrete and steel will be used.
- No harmful material will be used during installation.
- Standard construction waste will be generated during the installation of the buttresses. This will be kept to a minimum, contained in construction skips and disposed of at regular frequencies during the construction periods.
- No noise will be generated during the operation of the CSB after the modifications have been installed.
- Noise may be generated during implementation of the modifications to the CSB.

2.17 Impact on Original Design Bases

The CSB was originally designed by local engineers called BKS, circa 1981, as an industrial building with no safety functions. The available SABS codes of practice

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performed using internationally recognised codes of practice such as ACI 349 and ASCE 43-05. However, the existing design basis seismic inputs for the Koeberg plant are still used in these analyses.

The modifications to the CSB impact on SAR section II-8.1.4.3, in that the CSB shall now be seismically qualified according to JN745-NSE-ESKB-R-7435 [A2], instead of the previous assessment which was performed as part of the Re-racking project.

SAR update request number: **2422** (this update is for the entire phase 1 SFSP update).

Regarding the difference between the seismic inputs for the storage pad and the CSB structure:

The cask storage pad analysis and design used LS-Dyna (FEA) to perform a soil structure interaction analysis, versus this design which used seismic input generated from SHAKE 2000. LS-Dyna uses its own internal functions to generate the surface response from the soil properties used as inputs, i.e. with time history input at bedrock. For this modification the surface response was generated from SHAKE which is the industry standard. Both methods are acceptable, and although the generated spectra do differ in some aspects, they are similar in the frequencies which influence buildings.

2.18 Risk Assessment

A baseline risk assessment is to be completed by the appointed SHE Agent prior to the commencement of the site works. However, the following risks on the project should be noted:

- Working at heights
- Hot work
- Use of rotating equipment
- Work in the controlled zone of the CSB
- Presence of services to be detected prior to excavation unless hand excavation is done
- ALARA

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Installation plans, inspection plans, quality control plans and test plans as well as general safety plans to be approved prior to any construction commencing.

The presence of services will need to be verified and exposed by hand where affected by the proposed construction.

The contractor is to remain responsible for all temporary works required for the installation of the structural steel works and general building operations required for the construction/implementation.

3.0 REFERENCES - DESIGN

3.1 Design Bases

The design bases for the modifications to the CSB are as follows:

	Reference Name	Institution	Document Number	Release Year
[1]	Seismic Design Criteria for Structures, Systems, and Components in Nuclear Facilities	ASCE	ASCE/SEI 43-05	2005
[2]	Soil structure interaction analysis of Eskom Phase 1 & 2 ISFSI Pads	Holtec International	HI-2177756	Revision 3 1/12/2018
[3]	Seismic Analysis of Nuclear Safety Related Structures	ASCE	ASCE 4	1998
[4]	Seismic Design Criteria for Structures, Systems, and Components in Nuclear Facilities	ASCE	ASCE 43	2005
[5]	Consideration of external events in the design of nuclear facilities other than nuclear power plants with emphasis on earthquakes	IAEA	Tecdoc 1347	March 2003
[6]	Categorisation of Nuclear Facility Structures, Systems and Components for seismic design	ANSI/ANS	2.26	2004
[7]	Building Code Requirements for Structural Concrete	ACI	ACI 318M-11	2011
[8]	Code Requirements for Nuclear Safety Related Concrete Structures.	ACI	ACI 349M-06	2006
[9]	Specifications for Structural Steel Buildings	AISC	AISC 360M-05	2005
[10]	Specification for Safety-Related Steel Structures for Nuclear Facilities	AISC	AISC N690-06	2006
[11]	Minimum Design Loads for Buildings and Other Structures	ASCE	ASCE 7-16	2016
[12]	Foundation Engineering Handbook	R W Day	ISBN 0071740090	2010
[13]	Reinforced Concrete Design to SANS 10100-1	G Parrott	NA	2008
[14]	Geotechnical Investigation carried out for the proposed Floor Replacement in the Koeberg Cask Storage Building	Gondwana Geo Solutions	18-813 R01	June 2018
[15]	Assessment of CSB for DEC External Events - Seismic and Tsunami	Eskom	07147R-DRR0062	Revision 0 Sept 2020
[16]	Assessment of CSB for Extreme Wind and Other External Events	Eskom	07147R-DRR0063	Revision 0 Sept 2020

3.2 Other Reference Documents

Other documents that influenced, directed or constrained this design are as follows:

	Reference Name	Institution	Document Number	Release Year
	NNR Act 47, Section 51, PAIA 38(b).redaction of plant sensitive information			
[28]	Factual Report to NSE on a Geotechnical Investigation for the Koeberg Nuclear Power Station Investigation, Western Cape	MSJ Geotechnical Consulting Services	17-812R01	May 2017
[29]	CSB SARCA Cask Fire Hazard Evaluation	Holtec International	HI-2177726	2017
[30]	SANS 10400 – South African National Building Regulations	SANS	SANS 10400	2018

Reference Name	Institution	Document Number	Release Year
[31] Considerations of External Events for New Nuclear Installations	NNR	PP-0014	Rev 0
[32] Requirements on Risk Assessment and Compliance with Principal Safety Criteria for Nuclear Installations	NNR	RD-0024	2008

The following software is referenced in this document

Design / Analysis Software	Preparer / Author	Version Number & Serial no	V&V Revision Number	V&V Date
[33] Strand7	Strand7	Release 2.4.6	1.0.0.1	2011/10/28
[34] SHAKE 2000	Schnabel & Lysmer	2000	N/A	March 2003
[35] Abaqus FEA	Dassault Systems	Release 2018	N/A	N/A

4.0 ATTACHMENTS TO PART A

A1 Design Input Consideration Checklist

A2 JN745-NSE-ESKB-R-7435: Seismic and Wind Investigation of LLW and CSB

A3 Safety Evaluation

A4 ALARA Screening KFU-028

A5 Assessment of Compliance to SANS 10400

ATTACHMENT A1

DESIGN INPUT CONSIDERATION CHECKLIST

	DESIGN NUMBER: 07147DPDRR012	Applicable	Not Applicable
1	Basic functions of each system, structure, and component.	☒	☐
2	Performance requirements such as capacity, rating, system output.	☒	☐
3	Codes, standards and regulatory requirements including the applicable issue and/or addenda. If ASME III is used refer to the latest NRC 10 CFR 50.55a for any limitations of use.	☒	☐
4	Design process conditions such as pressure, temperature, fluid chemistry and radiation levels.	☒	☐
5	Operational requirements under various conditions such as plant start-up, shutdown, power operation or emergency operation.	☐	☒
6	Reactivity management considerations such as heat balance, boron concentration, burnup, poisons and control rod positioning.	☐	☒
7	Interface requirements including definition of the functional and physical interfaces involving structures, systems and components.	☒	☐
8	Mechanical requirements such as vibration, stress, shock and reaction forces.	☒	☐
9	Loads such as seismic, wind, thermal and dynamic.	☒	☐
10	Structural requirements covering such items as equipment foundations and pipe supports.	☒	☐
11	Hydraulic requirements such as pump suction and discharge elevations and pressures, allowable pressure drops and allowable fluid chemistry.	☐	☒
12	Chemistry requirements such as provision for sampling and limitations on water chemistry.	☐	☒
13	Electrical requirements such as source of power, voltage, impact on back up battery loading (in particular DTV), raceway requirements, electrical insulation and motor requirements.	☐	☒
14	Instrumentation and control requirements including indicating instruments, controls and alarms required for operation, testing and maintenance. Other requirements such as the type of instrument, installed spares, range of measurement and location of indication should also be included.	☐	☒
15	Software and programming requirements.	☒	☐
16	Environmental conditions anticipated during storage, construction and operation such as pressure, temperature, humidity, corrosiveness, site elevation, wind direction, nuclear radiation, electromagnetic radiation and duration of exposure.	☒	☐
17	Radiation exposure to the public and to plant personnel (application of the ALARA principle). Complete and attach KFU-028 if applicable.	☒	☐
18	Safety requirements for preventing personnel injury including such items as restricting the use of dangerous materials, escape provisions from enclosures, grounding of electrical systems and other conventional safety considerations.	☒	☐
19	Requirements to prevent undue risk to the health and safety of the public.	☒	☐
20	Material requirements including such items as compatibility, electrical insulation properties, protective coating and corrosion resistance, including flow accelerated and microbiologically induced corrosion.	☒	☐
21	Layout and arrangement requirements.	☒	☐
22	Accessibility, maintenance, repair and in-service inspection requirements for the plant, including the conditions under which these will be performed.	☒	☐
23	Relevant Operating Experience.	☒	☐
24	Redundancy, diversity and separation requirements of structures, systems and components.	☒	☐
25	Access and administrative control requirements for plant security.	☒	☐
26	Failure modes and effects considerations of structures, systems and components including a definition of those events and accidents for which they must be designed to withstand.	☒	☐
27	Fire protection or resistance requirements.	☒	☐
28	Common-mode failures and other common-mode effects.	☒	☐
29	Test requirements including in-plant tests and the conditions under which they will be performed. Are ASME XI leak tests in lieu of hydro tests justified in the design.	☐	☒
30	Personnel requirements and limitations including the qualification and number of personnel available for plant operation, maintenance, testing and inspection and permissible personnel radiation exposures for specified areas and conditions.	☒	☐

DESIGN NUMBER: 07147DPDRR012		Applicable	Not Applicable
31	Transportation, handling and storage requirements such as size, shipping weight and legal limitations.	☒	☐
32	Foreign Material Exclusion (FME) requirements during all intrusive mechanical work such as cutting, grinding and welding.	☒	☐
33	Effect of the design on the Control Room Human Engineering Factors.	☐	☒
34	Impact on the South African Grid Code – Complete and attach KFU-018 if applicable.	☐	☒
35	Diesel Generator Load Balance Performed.	☐	☒
36	Determined the effect on Severe Accident Management Guidelines?	☒	☐
37	Avoided selecting materials that contain zinc in components to be installed in containment.	☐	☒
38	Considered if there is an effect of the design on the RP Migration Model.	☐	☒
39	Has EDF implemented a similar modification, has this information been taken into account in this design? If so, are the input parameters similar?	☐	☒
40	Has this modification resulted in new classifications? Has the impact on technical specifications, procedures, transient files and programmatic controls been determined? Has the new classification been considered adequately for safety importance?	☐	☒
41	Have the conventional safety risks that will be present during construction been considered? Does the design consider constructability and the construction process?	☒	☐
42	Have KGU-035 and KGU-038 been considered with respect to Single Point Vulnerabilities, that is SPV's eliminated and /or no new SPV's introduced.	☐	☒
43	Microprocessor and Automation Design Checklist – Complete and attach KFU-019 if applicable.	☐	☒
44	Software Design Consideration Checklist – Complete and attach KFU-020 if applicable.	☐	☒
45	Effect on Environmental Qualifications – Complete and attach KFU-021 if applicable.	☐	☒
46	Was any EPRI guidance/report/study considered?	☐	☒
47	Was the PM Strategy Input Sheet (QFR-026) completed and attached?	☐	☒
48	Was the EPRI Gold Card Report (1022990) for new circuit card systems considered while completing the PM Strategy Input Sheet?	☐	☒
49	New electrical board loads calculated and original drawings updated with new values?	☐	☒
50	Have the appropriate drains been identified and are they being used?	☒	☐
51	Code reconciliation to ASME XI of new plant items not conforming to the DSE referenced construction code.	☐	☒
52	Compliance with the requirements of ANSI/ANS-58.8 Time Response Design Criteria for Safety-Related Operator Actions.	☐	☒
53	Has the system operator been informed of any modification, in particular GEV, GEX, GSY, GPA and LGR (including LGR protection settings) to determine if it affects Transmission protection equipment settings?	☐	☒
54	Have surface treatment processes on new equipment been evaluated in relation to the elimination or reduction of high dose radio-isotopes?	☐	☒
55	Have KLM-011 and KLM-012 been considered with respect to the required accuracy of any new instrumentation?	☐	☒
56	Have all of the hazardous location requirements been addressed?	☐	☒
57	Are any additional nuclear safety analyses necessary for the design and is there an update required to Koeberg analysis models and codes (e.g. PSA, MAAP, RELAP, and SCALE)?	☐	☒
58	Is the current design change being simultaneously implemented on the same system with another design change package and has the impact been assessed and been documented in the both design change packages?	☒	☐
59	Are the safety screening / evaluation and design input consideration checklist completed using the latest design scope changes?	☒	☐
60	Was the impact of new installations to combustible loading of fire sectors described in KLV-001 Appendix 8, considered?	☐	☒
61	Have all engineering programmes related documents and requirements been considered, e.g. PER, EQ, IST, CAMP?	☒	☐

DESIGN NUMBER: 07147DPDRR012	Applicable	Not Applicable

The design input requirements are correctly selected and reasonable

T Rylands		2019-02-14
COMPILER	SIGNATURE	DATE
D E Lee		2020-10-21
REVIEWER	SIGNATURE	DATE

PAIA 36(b).3rd Party.redaction of 3rd Party Reference information

NNR Act 47, Section 51, PAIA 38(b).redaction of plant sensitive information

NNR Act 47, Section 51, PAIA 38(b).redaction of plant sensitive information

ATTACHMENT A4

ALARA SCREENING FORM – KFU-028

Eskom	ALARA SCREENING FORM FOR DESIGN CHANGES	Reference No.: KFU-028	
		Revision: 1	Page: 1 OF 8
		Associated Procedure: KAA-815	

UNIT:	6HQB000BG	MODIFICATION NUMBER:	07147DPDRR012
DESCRIPTION OF MODIFICATI			

NNR Act 47, Section 51, PAIA 38(b).redaction of plant sensitive information

	DOES THIS DESIGN CHANGE INVOLVE:	YES	NO
A.	Activities that must be performed in, or require entry to, a current or future radiologically controlled area?	☒	☐
B.	Support activities such as cable runs, piping runs, hose runs, or air line runs that pass through a current or future radiologically controlled area?	☒	☐
C.	Receiving, shipping, releasing, discharging, processing, conveying, moving, or sampling of radioactive material?	☐	☒
D.	Calibrations involving radioactive material?	☐	☒
E.	Any process radiation monitoring system, area radiation monitoring system, or airborne radioactivity monitoring system or equipment.	☒	☐
F.	Shielding changes?:	☒	☐
G.	Any system or component that does or could contain, convey, or use radioactive materials?	☒	☐
H.	A change in a plant system, feature or condition that could increase radioactive effluents and/or onsite or offsite radiation dose levels? If "Yes " to question H, then an offsite radiation dose checklist must be completed.	☐	☒
I.	Use of special tooling, mock-ups, or equipment requiring radiological controls?	☐	☒
J.	Establishing plant conditions with potential radiological impacts, such as: decontamination, equipment isolation, tagouts, depressurization, draining, or flushing?	☐	☒
	Any "Yes" response requires an ALARA Design Review (complete pages 2 to 7).	☒	☐

UNIT:	6HQB000BG	MODIFICATION NUMBER:	07147DPDRR012
DESCRIPTION OF MODIFICATION:	Cask Storage Building Modifications		
•			
DESIGN ENGINEER:	Thaabit Rylands		

Subject Design / Modification is acceptable from an ALARA perspective	YES	☒	NO	☐

REVIEWED BY:	Pikkie Groenewald	(signature)	2018/02/18
	ALARA REVIEWER	SIGNATURE	DATE

ALARA REVIEW CHECKLIST

1.	Maintenance and Operations	YES	NO	N/A
1.1	Permanent platforms, walkways, stairs or ladders are provided to permit accessibility.	☐	☐	☒
1.2	Serviceable components are capable of being isolated and drained.	☐	☐	☒
1.3	Flange connections are provided for quick removal of high maintenance components.	☐	☐	☒
1.4	Insulation design allows for rapid removal.	☐	☐	☒
1.5	Surveillance can be performed from outside a high radiation area through the use of TV camera, viewing port, or remote readout.	☒	☐	☐
1.6	Built-in rigging is provided to facilitate component handling.	☐	☐	☒
1.7	Components are designed to facilitate flushing and decontamination.	☐	☐	☒
1.8	Components are designed and selected with consideration for long service life, ease of removal, and frequency of maintenance.	☒	☐	☐
1.9	Serviceable components are easily accessible with adequate work space, laydown areas, and lighting.	☒	☐	☐
1.10	Design features prevent personnel from inadvertently entering high radiation areas (in excess of 1000 µSv).	☐	☐	☒
1.11	Special provisions are made for ease of maintenance and operation of equipment.	☐	☐	☒
1.12	Layout of components/systems is in accordance with FSAR radiation zone classifications.	☒	☐	☐
	Justifications: (All "No" responses) (if necessary use continuation sheet at end of checklists).	☐	☐	☒

2.	Shielding	YES	NO	N/A
2.1	Has shielding analysis been performed? If yes, give calculation number. HI-2156867	☒	☐	☐
2.2	Entrances to high radiation areas are adequately shielded (e.g., labyrinth).	☐	☐	☒
2.3	Radioactive equipment is separated by shielding from non-radioactive equipment.	☐	☐	☒
2.4	Shield penetrations are minimized in size and number.	☐	☐	☒
2.5	Shield penetrations are located high on the wall and in a corner to avoid line-of-sight streaming.	☐	☐	☒
2.6	If the answer to 2.5 is NO, are the penetrations adequately shielded or sealed (e.g., use of high density sealant or equivalent)?	☐	☐	☒
2.7	Permanent shielding is employed, to the degree feasible, to prevent the need for temporary shielding.	☐	☐	☒
2.8	If permanent shielding is not feasible, provisions are made to allow temporary shielding during maintenance evolutions.	☐	☐	☒
	Justifications: (All "No" responses) (if necessary use continuation sheet at end of checklists.)			
	Temporary shielding wall is provided during construction activities to provide shielding from GNS Casks			
3.	Contamination Control:	YES	NO	N/A
3.1	Corrosion resistant material is used for piping and equipment.	☐	☐	☒
3.2	Low cobalt material is used for piping and equipment in contact with primary coolant.	☐	☐	☒
3.3	Curbs are provided to control the spread of liquid spills.	☐	☐	☒
3.4	There are radioactive floor drains inside the curbs.	☐	☐	☒
3.5	Floors slope toward the drains.	☐	☐	☒
3.6	Easily decontaminable coatings have been specified.	☐	☐	☒
3.7	Ventilation is provided to control airborne activity.	☐	☐	☒
3.8	Drain lines are sloped continuously and backflooding is prevented.	☐	☐	☒
	Justifications: (All "No" responses) (if necessary use continuation sheet at end of checklists.)	☐	☐	☐

4.	Liquid Systems - Tanks, Pumps, Sumps	YES	NO	N/A
4.1	Pumps are located apart from tanks they serve.	☐	☐	☒
4.2	Pumps are fitted with catch basins which are properly drained.	☐	☐	☒
4.3	Pump castings are provided with equipment drains.	☐	☐	☒
4.4	Pump seals are covered to prevent contaminated liquid from being slung away from the pump.	☐	☐	☒
4.5	Vents are provided.	☐	☐	☒
4.6	Pumps requiring frequent maintenance are equipped with flanged connections for easy removal.	☐	☐	☒
4.7	Canned pumps or mechanical seals are employed instead of standard packing glands.	☐	☐	☒
4.8	Tanks and sumps are designed with sloping bottoms.	☐	☐	☒
4.9	Tanks and sumps are provided with a mechanism for flushing and decontamination.	☐	☐	☒
4.10	Vents and relief valve tail pipes are routed to drains.	☐	☐	☒
	Justifications: (All "No" responses) (if necessary use continuation sheet at end of checklists.)			

5.	Liquid Systems – Valves	YES	NO	N/A
5.1	Valves are located away from tanks, filters, demineralizers, etc., where possible.	☐	☐	☒
5.2	Process valves are remotely operated (reach rods are acceptable).	☐	☐	☒
5.3	Valves are mounted with the stem facing up where possible.	☐	☐	☒
5.4	Platforms are provided for valve maintenance.	☐	☐	☒
5.5	There is sufficient space around the valve for efficient maintenance.	☐	☐	☒
5.6	Valve designs minimize cavities and crevices.	☐	☐	☒
5.7	The design eliminates the use of cobalt containing materials for parts or components (e.g., valve trim, seats, pins, etc.) that could be in a flow path leading to the reactor core.	☐	☐	☒
5.8	The design maximizes the removal of cobalt particulates from systems which can interface with the reactor coolant system.	☐	☐	☒
5.9	Valves can be installed or removed without cutting or welding.	☐	☐	☒
	Justifications: (All "No" responses) (if necessary use continuation sheet at end of checklists.)			

6.	Piping (None)	YES	NO	N/A
6.1	Crud traps are minimized and stagnant legs avoided.	☐	☐	☒
6.2	Socket welds are avoided.	☐	☐	☒
6.3	All sections of piping can be adequately drained..	☐	☐	☒
6.4	Vents are provided and piping can be flushed..	☐	☐	☒
6.5	Piping run is in a shielded pipe chase where possible.	☐	☐	☒
6.6	Piping run lengths and horizontal runs are minimized.	☐	☐	☒
6.7	Field joints are minimized.	☐	☐	☒
6.8	Piping is pretreated prior to installation (e.g., electropolish, prefilm)..	☐	☐	☒
6.9	Piping which potentially contains radioactive contaminants is physically separated from non-radioactive piping.	☐	☐	☒
6.10	Use of field-run piping is avoided.	☐	☐	☒
	Justifications: (All "No" responses) (if necessary use continuation sheet at end of checklists.)			

7.	Sludge and Slurry Systems	YES	NO	N/A
	In addition to considerations for liquid systems, systems containing slurries shall also meet the statements below.	☐	☐	☒
7.1	Sharp bends in pipes are avoided. (Five diameter or greater bends are acceptable.)	☐	☐	☒
7.2	Check valves or strainers are provided at interfaces with liquid systems.	☐	☐	☒
7.3	Backflush connections are provided.	☐	☐	☒
7.4	Ball valves are used whenever possible.	☐	☐	☒
	Justifications: (All "No" responses)			
	(if necessary use continuation sheet at end of checklists.)			

8.	Instrumentation	YES	NO	N/A
8.1	Instrument readouts are located in the lowest radiation area feasible.	☐	☐	☒
8.2	Instrument taps on liquid systems are located above the piping midplane.	☐	☐	☒
8.3	Existing radiation monitors are appropriate in terms of types and locations. (If No, indicate how existing radiation monitoring systems should be modified or what new systems will be required.)	☐	☐	☒
8.4	Instruments and controls are grouped functionally to minimize time spend in the area.	☐	☐	☒
8.5	Instruments are selected and specified for long service life and low maintenance requirements.	☐	☐	☒
8.6	There are provisions for remote calibration.	☐	☐	☒
8.7	Instruments can be flushed to reduce crud accumulation.	☐	☐	☒
	Justifications: (All "No" responses) (if necessary use continuation sheet at end of checklists.)			
	Instruments moved away as far away as process will allow			
9.	Ventilation	YES	NO	N/A
9.1	There are provisions for ventilating the area.	☐	☐	☒
9.2	The flow of air is from areas of lesser contamination to areas of greater contamination.	☐	☐	☒
9.3	Filter banks are readily accessible for maintenance.	☐	☐	☒
9.4	Filter banks are separated or shielded from each other to permit working on one with the other operating.	☐	☐	☒
9.5	The ventilation system (exclusive of filters) is designed to minimize activity buildup.	☐	☐	☒
9.6	Ventilation ducts have cleanout ports for decontamination.	☐	☐	☒
	Justifications: (All "No" responses) (if necessary use continuation sheet at end of checklists.)			

10.	**Filters/Demineralisers**	YES	NO	N/A
10.1	Vents and relief valve tail pipes are routed to drains.	☐	☐	☒
10.2	Filters and demineralisers have been assessed as radiation sources. (If yes, give calculation number.)	☐	☐	☒
10.3	Multiple filters or demineralisers are housed in separate cubicles to permit maintenance with the system operating.	☐	☐	☒
10.4	Filter cartridge sizes are common to other filters already in use at the plant.	☐	☐	☒
10.5	Filters are designed to minimize servicing frequency.	☐	☐	☒
10.6	Filters are designed for efficient removal.	☐	☐	☒
10.7	Filters are located in low occupancy and low traffic areas.	☐	☐	☒
10.8	There are features for remote or shielded methods of filter removal.	☐	☐	☒
10.9	Submicron filters are employed as applicable.	☐	☐	☒
	Justifications: (All "No" responses) (if necessary use continuation sheet at end of checklists.)			

11.	**Implementation Requirements (REQ)/Recommendations (REC)**	YES	NO	N/A
11.1	Radiation Work Permit	☒	☐	☐
11.2	Temporary Shielding.	☐	☒	☐
11.3	RADCON Instructions or Precautions	☒	☐	☐
11.4	Additional or Temporary Ventilation	☐	☐	☒
11.5	Temporary Containments	☐	☐	☒
11.6	Decontamination of System/Components/Work Areas..	☒	☐	☐
11.7	System Flushing.	☐	☐	☒
11.8	Tool List	☐	☐	☒
11.9	Special Installation	☐	☐	☒
11.10	QA/QC Inspection/Hold Points	☒	☐	☐
11.11	Support Work (Scaffolding, etc.)	☒	☐	☐
11.12	Special Training (Mock-up, Classroom).	☐	☐	☒
11.13	Plant Mode.	☐	☐	☒
11.14	Safety	☒	☐	☐

11.15 **NNR Act 47, Section 51, PAIA 38(b).redaction of plant sensitive information**

	COMMENTS:

	COMMENTS:

NNR Act 47, Section 51, PAIA 38(b).redaction of plant sensitive information

Personnel performing work on modifications inside the CSB and LLW will be exposed to radiation from casks and drums.
Normal RP procedures and monitoring will be applied during construction activities.

PREPARED BY:	Thaabit Rylands		2018-02-10
	NAME	SIGNATURE	DATE
REVIEWED BY: (ALARA)	Pikkie Groenewald		2018/02/18
	NAME	SIGNATURE	DATE

ATTACHMENT A5

ASSESSMENT OF COMPLIANCE TO SANS 10400

CSB/HQB COMPLEX MODIFICATION COMPLIANCE TO SANS 10400:

The SANS 10400 code: National Building Regulations is used to ensure that structures are code compliant in various aspects of habitability. The HQB complex was constructed in the early 1980's. There is no documented proof the structure was designed strictly according to the SANS 10400 codes of practice, although assessment of the construction and layout drawings indicate that structural components that comprise the CSB and LLW are adequately sized and specified with respect to the South African design codes for steel and concretes. It is not necessary to retroactively ensure that a building which is to be modified complies with SANS 10400, however it is necessary to show that the modifications to structure will not render the structure non-compliant. The relevance of SANS 10400 to the modifications to CSB are therefore discussed in the subsequent sections. It should be noted that only items affected by the modifications are considered, i.e. Concrete Walls, Concrete Slabs, Structural Steel works.

Part B: Structural Design

- CSB modifications provides additional strength and stability to structure to not impair the integrity of other buildings.
- Part B states that the design of the structure must be carried out in accordance with SANS 10160 – for loading and in accordance with the relevant SANS codes. However, this structure is a specialized structure which is situated in a nuclear environment and must adhere to nuclear related codes. Hence the ACI 349 code of practice was used. Work done by NSE shows that ACI and SANS concrete design codes give similar results, and that in most cases, the ACI codes gives more conservative results.
- Loading is plant specific over and above the SANS loading code and the relevant codes used for design of nuclear related structures.
- Professional engineers carried out the design through code of practice and rational methods. The design was checked by professional engineers as well.

Part J: Floors

- The concrete floor/slab is subject to rational design in accordance with Part B
- Concrete floor slab that is supported on ground or filling to be constructed in such a way that it prevents moisture from penetrating.

NNR Act 47, Section 51, PAIA 38(b).redaction of plant sensitive information

Part K: Walls

- The walls are subject to rational design in accordance with Part B.
- The existing walls are
- The modified design is checked against ACI 349 code of practice which is in most cases more conservative than SANS codes of practice with respect to structural design.

Part L: Roof

- The roof assembly is an existing one. Modification design such as additional gusset plates, roof truss connection strengthening, brace strengthening, etc. are subject to rational design in accordance with Part B.

- The structural capacity of the roof is increased by the modifications. Hence it does not result in non-compliance with respect to structural design rules as intimated by the code of practice.
- Roof is and remains durable and waterproof.
- Roof is an existing structure, and it is evident that basic design principles of roofing layout and design have been implemented. It is evident that the initial design took into consideration issues related to waterproofing, minimum slopes and roof sheet end laps and flashing.
- Provides adequate height clearance to any room immediately below it
- Roof structure is non-combustible. Furthermore, the CSB is an area demarcated as a combustible free zone and therefore, does not require any fire protection coating.

Part T: Fire Protection

- The fire protection of the existing structure is not compromised by the effects of the proposed modifications to the CSB structures.

NUCLEAR ENGINEERING DEPARTMENT

DESIGN ENGINEERING

CASK STORAGE BUILDING MODIFICATIONS STRUCTURAL DESIGN REPORT

PART B: MANUFACTURING AND INSTALLATION SPECIFICATION

1.0 SCOPE

This section describes the manufacturing and installation of modifications to the CSB described in Part A of this document.

NNR Act 47, Section 51, PAIA 38(b).redaction of plant sensitive information

2.0 REFERENCES - INSTALLATION

The following documents are applicable to manufacturing and installation of this structure:

2.1	KAA-501:	Modifications to Plant, Plant structures or Operating Parameters that Affect the Design Base.
2.2	OHSA No 85/93:	Occupational Health and Safety Act No. 85 of 1993.
2.3	SANS 9001:	Quality Management Systems – Requirements.
2.4	331-170:	Corrosion Protection Maintenance Manual.
2.5	SANS 1200 C	Standardized specification for civil engineering construction – Section C: Site Clearance
2.6	SANS 1200 DA	Standardized specification for civil engineering construction – Section DA: Earthworks (Small Works)
2.7	SANS 1200 GA	Standardized specification for civil engineering construction – Section GA: Concrete (Small Works)
2.8	SANS 1200 H	Standardized specification for civil engineering construction – Section H: Structural Steelwork
2.9	SANS 1200 HA	Standardized specification for civil engineering construction – Section HA: Steel work (Sundries)
2.10	SANS 1200 HB	Standardized specification for civil engineering

		construction – Section HB: Cladding and Sheeting
2.11	SANS 1200 L	Standardized specification for civil engineering construction – Section L: Medium Pressure Pipelines
2.12	SANS 10100-2	The Structural Use of Concrete – Part 2: Materials and execution of work
2.13	SANS 2001	Construction Works
2.14	SANS 5861-2	Concrete testing – Sampling of freshly mixed concrete
2.15	SANS 5861-3	Concrete testing – making and curing of test specimens
2.16	SANS 5863	Concrete testing – Compressive strength of hardened concrete
2.17	SANS 10162-1	The structural use of steel Part 1: Limit-state design of hot-rolled steelwork
2.18	The Red Book	Southern African Steel Construction Handbook 2013
2.19	SANS 282	Bending dimensions and scheduling of steel reinforcement for concrete
2.20	SANS 920	Steel bars for concrete reinforcement

3.0 QUALITY ASSURANCE

Refer to the Bill of Materials in Part C of this document for information regarding the safety class and quality level of specific items.

The project manager is responsible for ensuring that the appropriate Safety Class equipment is procured and that the correct Quality Assurance Programme is implemented by the supplier.

The structures and equipment to be installed do not require special quality assurance requirements apart from the procurement specifications listed in part C, and the fabrication requirements and standards specified in the construction / fabrication drawings as well as reference documents detailed in Section 2 above.

The appointed contractor responsible for the construction, shall provide Eskom with method statements for all construction work activities e.g. for the erection (access arrangements, lifting and rigging) of the structural steelwork. These method statements shall be used to develop Quality Assurance procedures for the construction works to be executed.

All equipment and material in the installers scope of supply shall be as per the project specifications, or of a quality and type approved by the SANS or any other relevant standard, as approved by Eskom. Where such approval does not exist, the installer shall submit samples to Eskom or their appointed representatives for approval. The samples shall be retained for reference purpose for the duration of the contract. All material supplied by the contractor shall be accompanied by the relevant approval certificates of quality and technical specification.

No equipment shall be installed unless it complies with the requirements stipulated in this specification or an approval has been granted by the Engineer.

4.0 INTERFACES WITH EXISTING PLANT

All modifications are in and around the CSB and LLW buildings. The modifications will not impact on the operating plant, but may impact on day-to-day general plant activities in the vicinity of the HQB complex. An alternative storage area of the contents of the Dry Resin Storage area must be found.

NNR Act 47, Section 51, PAIA 38(b).redaction of plant sensitive information

No operator training is required.

5.0 MANUFACTURING AND PREPARATION

All personnel involved in the construction and installation on-site, shall undergo the necessary fitness for duty training and meet Eskom's minimum requirements for access to the work site.

All personnel shall have the necessary qualifications, skills and training to undertake the work assigned to them.

The items detailed below shall be fabricated / procured according to the fabrication drawings provided in the attachments to this Part B, codes, standards and specifications detailed in Section 2.0 and Part A of this document.

Long lead items should be timeously procured to ensure that the items are readily available prior to start of installation. The installer is to ensure that the specifications are adhered to and any equivalent item ordered checked by the designer or relevant Eskom personnel prior to order.

NNR Act 47, Section 51, PAIA 38(b).redaction of plant sensitive information

5.1 Prefabrication of Structural Steel Items

This section applies to structural steel building lattice frames, sag bars, sheeting rails, etc., and ancillary structural steel elements such as fasteners, cleats, bolts, base and end plates, etc.

- The structural steel engineering design drawings will be used by the steel fabricator to draw-up detailed shop drawings for the structural steel components required for the modification of the CSB roof and wall stiffening elements.
- These shop drawings are to include all fabrication details, inclusive of dimensions, connection details, assembly details, etc.
- Shop drawings are then submitted to the design engineers for review and approval.
- Subsequent to corrections, amendments and / or incorporation of any comments that may be required, individual components of the structure are then fabricated in the workshop.
- The steel shall be free from loose mill scale, surface defects, flaky rust, laminations, pitting, and, be of full weight or thickness within tolerances specified in the standards. All steel material shall be straight and free from distortions.
- Edges of all cut structural steel shall be perfectly straight and uniform throughout, and, free from distortion and burrs. Edge preparations for welding shall be done in the workshop.
- All site connections shall be as per the design drawings. Any deviation shall be approved by the Engineer before implementation thereof.
- The edges of surfaces of members to be joined by welding shall be uniform, smooth and cleaned from all foreign material, e.g. moisture, oil, scale, rust, etc. Non-destructive testing of welds shall be performed as per the requirements of the applicable standards and specifications detailed in Section 2 above. A third-party inspection agency shall be engaged as an independent and approved testing and inspection agency to certify the welding works performed, as required.
- Punching or drilling of holes shall be done accurately as per the shop drawings and burns removed effectively. All holes shall be a minimum of 1.5mm larger than the bolt size.
- The prefabricated steel items shall be inspected in accordance with the approved fabrication drawings and specifications. Overall length, orientation, diagonal measurements, and all other dimensions shall be verified. If dimensions are not within required tolerance, the member shall be corrected prior to further processing.
- Corrosion protection and paint shall be applied to dry, cleaned prepared surfaces of the fabricated structure, in a controlled environment under favourable weather conditions (as per the reference 2.4 in Section 2).

- Tests required to confirm correctness of welds, dry film thicknesses of coatings, fabrication tolerances, etc., to be done in the workshop prior to dispatch of the structural steel work to site.
- The painted structures after fabrication shall be protected from further damage during transportation. The materials will be loaded on to trailers using timber supports and separators and secured properly to prevent any damage to the material whilst transportation to site. These will be stored similarly on site.
- An approved Inspection and Test Plan (ITP) shall be implemented during each and every stage of fabrication to ensure that the work is carried out with full compliance to the drawings and specifications.

5.2 Prefabrication of Steel Reinforcement for Concrete

- Steel reinforcement for the concrete works shall be cut and bent in accordance with the bending schedules provided.
- All steel reinforcement shall comply with references 2.19 and 2.20.
- Reinforcement shall be handled and stored to prevent damage, excessive corrosion, and permanent deformation.

6.0 INSTALLATION

6.1 HEALTH AND SAFETY

- All work shall be carried out in accordance with OHSA No 85/93: Occupational Health and Safety Act No 85 of 1993, as well as the Construction Regulations - 2014.
- All rigging and lifting work shall be in accordance with Eskom procedure KSA-132.
- In case of adverse weather conditions (rain, excessive winds, etc), lifting operations will be suspended.
- Valid certification of all lifting equipment will be verified prior to operation.
- When working at height (height of more than 1.5m from ground level), harnesses shall be fixed to a safety life line.
- Work area to be barricaded.
- Rigging study / lifting plan to be provided by the contractor and approved by Eskom prior to the commencement of the works.
- All workers within the demarcated construction site shall wear PPE as required by the approved safety file.
- Contractors OHS plan, risk assessments, quality plans and method statements to be approved prior to any construction commencing.

6.2 CONCRETE STIFFENER CONSTRUCTION - REFER TO ATTACHMENT B1

NNR Act 47, Section 51, PAIA 38(b).redaction of plant sensitive information

6.2.1 Setting Out for Earthworks

- Prior to the commencement of the works, survey works will be carried out to identify and confirm the location of all underground services.
- Benchmarks and control points shall be verified and fixed on site.
- The setting out of the structure shall be verified in accordance with the design drawings.

6.2.2 Earthworks

- Site clearing, specifically the removal of vegetation shall be performed by Eskom before proceeding with any earthworks.
- Fill material may be required in some areas to achieve the required level for the mid-height concrete stiffeners.
- If there are areas where the level is uneven, backfilling and compaction shall be carried out to achieve the required level and density specified in the construction drawings. Fill material may be sourced from stockpiles of in-situ sands from the Koeberg site, or imported G5 fill.
- Location of stockpiles for imported material must be provided by Eskom before commencement of the earthworks.
- All excavations shall be barricaded and protected as per reference 2.2.
- In-situ material shall be compacted to at least 95% Mod AASHTO density.
- In-situ tests to be performed on the compacted material to confirm that the minimum density is achieved. Positions and results to be logged and recorded.

6.2.3 Preparation for Cast In-Situ Concrete Work

-

NNR Act 47, Section 51, PAIA 38(b).redaction of plant sensitive information

6.2.4 Concrete Placement, Finishing and Curing

NNR Act 47, Section 51, PAIA 38(b).redaction of plant sensitive information

6.3 STRUCTURAL STEEL INSTALLATION – REFER TO ATTACHMENT B1

The following modifications to the CSB and LLW building involves the installation

NNR Act 47, Section 51, PAIA 38(b).redaction of plant sensitive information

6.4 ANCILLARY WORKS

7.0 MARKING AND IDENTIFICATION

There are no permanent marking or identification requirements for the modification to the CSB and LLW building structures. However, marking and identification of components and parts of the structure required for the purposes of assembly and construction (e.g. rebar, steel lattice sections, plate types, etc.), shall be in accordance with the fabricator's specification, or as per the bending schedules in the case of rebar.

8.0 VERIFICATION AND TESTS

8.1 General

- Installations shall be inspected and tested in accordance with the project specifications, reference documentation detailed in Section 2 above, detailed drawings and the manufacturer's specifications, instructions and recommendations as applicable.
- Verify and approve contractor's method statements for all construction activities and installations.
- Verify and approve the contractor's Health and Safety plan as well as Quality Control plan (inclusive of ITPs).
- Verify that all material is approved for use and the certificates are available.
- After completion of construction, all installations shall again be visually inspected in conjunction with the Eskom supervisor or Project QC staff in order to ensure that the project and supplier specifications have been met.
- Eskom project manager to provide a certificate of completion after all works, verifications and testing has been completed and approved.

8.2 Concrete

- Verify that the following records are available:
  - All concrete batch plant certificates

- In-situ material density testing records
- All pre-concrete placement inspection records are available and signed
- All required cube test results
- All on-site test records such as slump test results

8.3 Structural Steel Installation

- Verify that welding test results and certification is available from the fabricators of the structural steel.
- Verify that there is no damage to the structural elements, prior to, and after installation (inclusive of damage to coatings).
- Ensure touch-up painting is completed.
- Verify that anchor bolts and connection points are not damaged.
- Verify that all bolted connections are tightened on completion of the installation.
- Verify that interface between baseplates of knee brace and wall connections are sealed with sealant and Denso tape.

8.4 Installation of Additional Side Cladding

- Verify that sheeting and cladding to be installed is free from damage (scratches, creases, etc.).
- Verify that sheeting and insulation certification confirming specifications thereof are provided by the contractor.
- Verify that all ancillary elements are installed as per manufacturer's specifications and as detailed on the drawings.
- Verify that overlaps between sheeting as well as eaves, gable ends, etc. are weatherproof.
- Verify that adequate fixings are installed to secure all items (sheeting, flashings, etc.) are in place.
- Verify that all manufacturers installation instructions are implemented.

9.0 DOCUMENTATION

All documents listed on the DCIF should be updated and available as soon after commissioning as possible and the project manager is to ensure that all documents accurately reflect the as-built status of the plant.

10.0 PACKAGING, SHIPPING, RECEIVING, STORAGE AND HANDLING

There are no specific packaging, shipping, receiving, storage and handling requirements (apart from general care required to prevent damage to the materials to be installed) associated with this construction, and those specified in the applicable references in Section 2 above, as well as supplier's and manufacturer's instructions and specifications. Care must be taken to ensure that all equipment, are protected from weather damage whilst being stored.

11.0 ATTACHMENTS TO PART B

B1 NEW DRAWINGS

B2 GENERAL SPECIFICATION FOR LLW BUILDING CLADDING REPAIRS

NNR Act 47, Section 51, PAIA 38(b).redaction of plant sensitive information

NNR Act 47, Section 51, PAIA 38(b).redaction of plant sensitive information

NNR Act 47, Section 51, PAIA 38(b).redaction of plant sensitive information

NUCLEAR ENGINEERING DEPARTMENT

DESIGN ENGINEERING

CASK STORAGE BUILDING MODIFICATIONS STRUCTURAL DESIGN REPORT

PART D: OTHER ATTACHMENTS

ATTACHMENT D1

DOCUMENTATION CHANGE IDENTIFICATION FORM (DCIF)

REVISED DOCUMENTS

Reference	Rev	Title	NNR Approval? Yes/No	Issue to Ops? Yes/No	Change Ref. Number
0.46/4478			no	no	DDR 2019/00181
0.46/4479			no	no	DDR 2019/00182
0.46/4548			no	no	DDR 2019/00183
0.46/4550			no	no	DDR 2019/00184
0.46/4591			P1 no	no	DDR 2019/00185
0.46/4709			no	no	DDR 2019/00186
0.46/4781			no	no	DDR 2019/00187
0.46/4782			no	no	DDR 2019/00188
0.46/4783			no	no	DDR 2019/00189
0.46/4784			no	no	DDR 2019/00190
0.46/4549			no	no	DDR 2019/00191
0.46/4550			no	no	DDR 2019/00192
KBA0603Y601000			no	no	DDR 2019/00193
0.46/4480			no	no	DDR 2019/00194
0.46/4839			no	no	DDR 2019/00195
0.46/4547			no	no	DDR 2019/00196
0.46/4578			no	no	DDR M20/0005

NNR Act 47, Section 51, PAIA 38(b).redaction of plant sensitive information

WITHDRAWN DOCUMENTS

Reference	Rev	Title	NNR Approval? Yes/No	Change Ref. Number
none		not applicable		

NEW DOCUMENTS

Reference	Rev	Title	NNR Approval? Yes/No	Issue to Ops? Yes/No	Change Ref. Number
JN745-NSE-ESKB-DWG-7734			NO	NO	DDR 2019/00197
KBA0603Y601014					
JN745-NSE-ESKB-DWG-7731-01			NO	NO	DDR 2019/00198
KBA0603Y601015					
JN745-NSE-ESKB-DWG-7731-02			NO	NO	DDR 2019/00199
KBA0603Y601016					
JN745-NSE-ESKB-DWG-7731-03			NO	NO	DDR 2019/00200
KBA0603Y601017					
JN745-NSE-ESKB-DWG-7732-01			NO	NO	DDR 2019/00201
KBA0603Y601018					
JN745-NSE-ESKB-DWG-7732-02			NO	NO	DDR 2019/00202
KBA0603Y601019					
JN745-NSE-ESKB-DWG-7732-03			NO	NO	DDR 2019/00203
KBA0603Y601020					
JN745-NSE-ESKB-DWG-7732-04			NO	NO	DDR 2019/00204
KBA0603Y601021					
JN745-NSE-ESKB-DWG-7733-01			NO	NO	DDR 2019/00205
KBA0603Y601022					
JN745-NSE-ESKB-DWG-7733-02			NO	NO	DDR 2019/00206
KBA0603Y601023					
JN745-NSE-ESKB-DWG-7733-03			NO	NO	DDR 2019/00207
KBA0603Y601024					
JN745-NSE-ESKB-DWG-7736			NO	NO	DDR 2019/00208
KBA0603Y601025					
JN745-NSE-ESKB-DWG-8305			NO	NO	M20/0086
KBA0603Y601027					

DOCUMENTS TO BE CONSIDERED

		YES	N/A
1.0	**DSE DOCUMENTS**		
1.1	Logic Diagrams	☐	☒
1.2	Control Loops	☐	☒
1.3	Controls Available to the Operator	☐	☒
1.4	Information Available to the Operator	☐	☒
1.5	Valve Lists	☐	☒
1.6	Data Sheets	☐	☒
1.7	Control and Instrumentation	☐	☒
1.8	Flow Diagrams	☐	☒
1.9	Instrumentation Diagrams	☐	☒
1.10	KIT Unit Description	☐	☒
1.11	Relay Racks	☐	☒
1.12	Actuators List	☐	☒
1.13	General Design & Operating Parameters	☐	☒
2.0	**ELECTRICAL AND INSTRUMENTATION**		
2.1	Measure Connecting Diagrams	☐	☒
2.2	Control Connecting diagrams	☐	☒
2.3	Control and Regulation Measurement Tapes	☐	☒
2.4	Electrical Materials Location	☐	☒
2.5	Feeder Diagrams and Lists	☐	☒
2.6	Alarm lists (KBAxx22E021003; KBAxxKSC900, 910) and diagrams	☐	☒
2.7	Process Inst., System Piping Way	☐	☒
2.8	Materials Lists	☐	☒
2.9	KIT Listing	☐	☒
2.10	Cable Pulling Listing	☐	☒
2.11	Main Cable Racks	☐	☒
2.12	Individual Cable Racks	☐	☒
2.13	Mechanical Diagrams for Instrumentation	☐	☒
2.14	EDG Power Balance KBA1217000090/91	☐	☒
3.0	**SETPOINT MANUAL**		
3.1	NSSS Setpoint Manual	☐	☒
3.2	BNI Setpoint Manual	☐	☒
3.3	Other Setpoint Documents	☐	☒
4.0	**SPECIFICATIONS**		
4.1	Contractor Specifications	☐	☒
4.2	Eskom Specifications	☐	☒

		YES	N/A
5.0	**CLASSIFICATIONS**		
5.1	Component Classifications	☐	☒
5.2	Parts Classifications	☐	☒
5.3	Software Classifications	☐	☒
6.0	**MECHANICAL ERECTION DRAWINGS**		
6.1	Mechanical Installation Drawings	☐	☒
6.2	Pump Installation Drawings	☐	☒
6.3	Material Location Drawings	☐	☒
7.0	**PIPING DRAWINGS**		
7.1	General Installation Drawings	☐	☒
7.2	Support Books	☐	☒
7.3	Isometric Drawings	☐	☒
7.4	Penetration Drawings	☐	☒
7.5	Tank Drawings	☐	☒
7.6	Bottle Level	☐	☒
8.0	**VENTILATION SYSTEM DRAWINGS**		
8.1	Electrical Materials Location	☐	☒
8.2	Mechanical Materials Location	☐	☒
8.3	Isometric Drawings	☐	☒
9.0	**MAINTENANCE**		
9.1	Maintenance Basis Documents (Component Eng. controls updates)	☐	☒
9.2	Service Notifications	☐	☒
9.3	Maintenance Manuals	☐	☒
10.0	**IMPORTANT CALCULATIONS**		
10.1	Secondary Heat Balance	☐	☒
10.2	Setpoint Calculations	☐	☒
11.0	**SAFETY ANALYSIS REPORT (SAR)**	☐	☒
12.0	**OPERATING TECH. SPECS (OTS)**	☐	☒
13.0	**OTHER LICENCE DOCUMENTS**	☐	☒

DOCUMENTS TO BE CONSIDERED

		YES	N/A
14.0	**OPERATING PROCEDURES**		
14.1	KWB-AA-xx	☐	☒
14.2	KWB-1AA-xx	☐	☒
14.3	KWB-2AA-xx	☐	☒
14.4	KWB-9AA-xx	☐	☒
14.5	KWB-1-LAS-xx	☐	☒
14.6	KWB-2-LAS-xx	☐	☒
14.7	KWB-F-xx	☐	☒
14.8	KWB-FP-xx	☐	☒
14.9	KWB-PT-xx	☐	☒
14.10	KWB-G-xx	☐	☒
14.11	KWB-GS-xx	☐	☒
14.12	KWB-OP-xx	☐	☒
14.13	KWB-R-xx	☐	☒
14.14	KWB-RT-xx	☐	☒
14.15	KWB-S-xx	☐	☒
	INCIDENT/ACCIDENT CONDITIONS		
14.16	KWB-E-xx	☐	☒
14.17	KWB-ECA-xx	☐	☒
14.18	KWB-ES-xx	☐	☒
14.19	KWB-FR-xx	☐	☒
14.20	KWB-I-xx	☐	☒
14.21	KWB-SACRP-xx	☐	☒
15.0	**SEVERE ACCIDENT MANAGEMENT GUIDELINES – KGG - xxx**	☐	☒
16.0	**OTHER NON OPS PROCEDURES**		
16.1	Maintenance Procedures – KWM-xx	☐	☒
16.2	Chemistry Procedures – KWC-xx	☐	☒
16.3	Radwaste Procedures – KWW-xx	☐	☒
16.4	Test Procedures – KWR-xx	☐	☒
16.5	Training Procedures	☐	☒
16.6	Administrative Procedures	☐	☒
16.7	Lists – KLA-001, KLM-001, etc. Hazardous Locations Listings	☐	☒
16.8	Offsite Procedures Check with IPS Co-Ordinator for applicability i.e. OPS Support.	☐	☒
16.9	KBA0000 G00 032 – List of Systems	☐	☒
17.0	**SAFETY RELATED SURVEILLANCE MANUAL (SRSM) VALIDATION**		
17.1	Test Procedures – KBA 0022 - SRM-xx-TR	☐	☒
18.0	**ELECTRONIC DATABASES**		
18.1	SAP Updates (including New Stock Application Form)	☐	☒
18.2	PERICLES (SDE controls the updates)	☐	☒
18.3	CLASSIFICATION DATABASE (Specifications Engineering controls the updates)	☐	☒
18.4	Human Operator Critical Actions Database (Nuclear Analysis controls the update)	☐	☒
18.5	Hazloc Locations Database	☐	☒
18.6	Torque Setting Database (Component Engineering)	☐	☒
18.7	EQ (Equipment Qualification) Database	☐	☒
19.0	**ENGINEERING PROGRAM REQUIREMENTS**		
19.1	Cable Ageing Management	☐	☒
19.2	Pressure Equipment Regulation	☐	☒
19.3	Environmental Qualification	☐	☒
19.4	In-Service Testing	☐	☒
19.5	In-Service Inspection	☐	☒
19.6	Steam Generator	☐	☒
19.7	Flow Accelerated Corrosion	☐	☒
19.8	Thermal Performance	☐	☒
19.9	Civil Monitoring	☐	☒
19.10	Microbiologically Induced Corrosion	☐	☒
19.11	Atmospheric Stress Corrosion Cracking	☐	☒
19.12	Corrosion Management	☐	☒
19.13	Boric Acid Corrosion	☐	☒
20.0	**PROTECTION DESIGN FILES (PDFs)**		
20.1	File No. 0 – Preliminary File	☐	☒
20.2	File No. 1 – Reactor Nuclear Protection	☐	☒
20.3	File No. 2 – Reactor Protection Against Overpower and DNB	☐	☒

DOCUMENTS TO BE CONSIDERED

		YES	N/A
20.4	File No. 3 – Protection Against Abnormal Pressure and Temperature Variations in the Reactor Coolant System	☐	☒
20.5	File No. 4 – Protection Against Reactor Coolant Flow Reductions	☐	☒
20.6	File No. 5 – Reactor Protection Against Steam Generator Feedwater System Malfunctions	☐	☒
20.7	File No. 6 – Protection Against Steam Generator Water or Steam Pipe Rupture	☐	☒

ATTACHMENT D2

NUCLEAR ENGINEERING DEPARTMENT

SYSTEM DESIGN ENGINEERING

CASK STORAGE BUILDING MODIFICATIONS STRUCTURAL DESIGN REPORT

PROJECT TEAM CONCURRENCE

I have verified that this document correctly and fully addresses the impact of this modification on my group / specialist field.

Group	Name	Signature
System Engineer	Bienyamien Francis	
Operations Support	N/A	
Civil Maintenance	Amanda Ludidi	Ludidi
Component Engineering	N/A	
Process Computing	N/A	
Project Engineering	Alan Lawrence	ALawrence.
OTS	N/A	
SAR	Cate Pretorius	Pretorius
OPG	N/A	
KSA custodian	N/A	
Hazloc - Committee Chairman or Representative	N/A	
Fire Risk Management	Rhine Barnes	
ALARA	Pikkie Groenewald	

Radwaste	Carla Le Roux	
SAMG	N/A	
Equipment Qualification and other Programmes (Incl ISI, IST, FAC, Ageing Matrix and MIC)	N/A	

Concurrence Comments / Reservations:

Name	Group	Ext

Name	Group	Ext

Name.	Group	Ext

Radwaste	Carla Le Roux	
SAMG	N/A	
Equipment Qualification and other Programmes (Incl. ISI, IST, FAC, Ageing Matrix and MIC)	N/A	

Concurrence Comments / Reservations:

Name:	Group:	Ext:

Name:	Group:	Ext:

Name:	Group:	Ext: